

Injecting drug users, sex workers and men who have sex with men: a national cross-sectional study to develop a framework and prevalence estimates for national HIV/AIDS programmes in the Republic of Serbia

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ABSTRACT

Objective: The aim of this study was to develop a framework and best estimates of prevalence for the most at risk populations (MARPs) for HIV/AIDS to include sex workers (SW), men who have sex with men (MSM) and injecting drug users (IDUs) in order to evaluate national HIV/AIDS programmatic targets across the Republic of Serbia.

Design: A national, cross-sectional study and direct enumeration, multiplier and benchmark methods with integrated bio-behavioural surveys, capture/recapture and methods with Wald and Clopper-Pearson CIs were used.

Setting: This study was carried out in the three largest cities and main regions of Serbia, the capital city, Belgrade, (population 1 639 121 persons), the Vojvodina region with main city Novi Sad (population 335 701) and the rest of Serbia with main city Nis (population 257 867).

Participants: A total of 1301 respondents from the defined MARPs completed the survey in the 2009/2010 period across the three cities.

Primary outcome measures: Estimates of the hidden numbers at risk of HIV/AIDS.

Results: It was estimated that there were 1775–6027 SW between 18 and 49 years in Serbia in 2009. For MSM, national estimates for 2009 ranged from 20 789 to 90 104 individuals aged between 20 and 49 years. For IDU, a possible range of 12 682–48 083 individuals aged between 15 and 59 years in 2009 was estimated.

Conclusions: For service planning across Central and Eastern Europe, it is important to highlight how credible estimates can be achieved and compared with numbers within HIV/AIDS-prevention programmes. Within needle exchange programmes, only 5.4–20.5% of the estimated population was observed and this proportion was lower within methadone treatment data. Results have implications for future IDU treatment and HIV incidence and spread across all populations at risk.

ARTICLE SUMMARY

Article focus

Research questions

- What is a practical framework for estimating prevalence of those populations most at risk of HIV/AIDS in a Central and Eastern European setting?
- What is the hidden prevalence of sex workers (SW), men who have sex with men (MSM) and people who inject drugs across all major cities of the Republic of Serbia?
- Are programmatic targets within national HIV/AIDS prevention programmes being met?

Key messages

- A practical framework for national prevalence estimates agreed across a range of varying service providers was developed and may be implemented by other countries.
- Estimates of the prevalence of SW ranged from 1 775 to 6 027 individuals aged between 18 and 49 years, estimates of the prevalence of MSM ranged from 20 789 to 90 104 individuals aged between 20 and 49 years and estimates of the prevalence of injecting drug users (IDU) ranged from 12 682 to 48 083 individuals aged 15–59.
- Results revealed that programmatic targets were not being met and proportions of populations at risk, reached by HIV/AIDS intervention programmes ranged from 1% to 50%.

Strengths and limitations of this study

- The study provided the first published, national prevalence estimates and rates endorsed by service providers of those most at risk of HIV/AIDS in the Republic of Serbia.
- The study highlighted the scale of the problem and future challenges for HIV/AIDS prevention programmes in Central and Eastern Europe.
- The main limitation of this study was the lack of data available outside the large cities and the lack of data available within a common year or age range across the three populations at risk.

INTRODUCTION

The importance of continuing work on national prevalence estimates of those most at risk of HIV/AIDS has been addressed across the globe from Pakistan¹ to the Sudan² to South Africa³ to the Netherlands and beyond.⁴ Within this research, a framework and the most comprehensive range of approaches to date, for the estimation of the size of the populations most at risk of HIV/AIDS across the Republic of Serbia, were developed.

The Plan for Monitoring and Evaluation of the Strategic Response to HIV infection and AIDS for the Republic of Serbia, 2011–2015⁵, clearly outlines within its first priority for intervention, a list of key programmatic targets for numbers of individuals each year, within defined risk groups, to be reached by the prevention programmes. These defined most at risk populations (MARPs) include, injecting drug users (IDU), men who have sex with men (MSM), sex workers (SW), prisoners, vulnerable children and youth and, finally, people with disabilities. In addition, within the plan,⁵ in order to monitor and evaluate progress on these programmatic targets, key impact and outcome and coverage indicators have been defined based on the United Nations General Assembly Special Session (UNGASS) and the Global Fund to fight AIDS, TB and Malaria (GFATM).^{6,7}

In order to evaluate the target set within the programmes and the indicators, to measure the coverage of prevention and treatment programmes and to plan for future HIV/sexually transmitted diseases and substance use prevention and treatment services, the estimates of the current prevalence within MARPs for HIV/AIDS were required as an urgent first step. These three were, IDU, MSM and SW.

METHODS

Setting

The Republic of Serbia is a landlocked country in the central part of the Balkan Peninsula in central south-eastern Europe. According to the 2011 census, Serbia has 7 120 666 inhabitants.⁸ In terms of HIV infection, Serbia belongs to the group of low-prevalence countries and data from the Serbian Public Health Institute state that in 2010 the cumulative number of HIV infections was 2593. This study was carried out in the three largest cities and main regions of Serbia, the capital city, Belgrade (city population of 1 639 121 persons), the Vojvodina region with main city Novi Sad (city population of 335 701) and the rest of Serbia with main city Nis (city population of 257 867).

Methods

To provide the estimates of the prevalence of the MARPs for HIV/AIDS, a range of direct and indirect methods were chosen, these were, single source enumeration, multiplier and benchmark methods, two sample capture/recapture methods and two previous population surveys in 2006.^{9,10} One survey on health¹¹ and one

on drug use¹² were based on the guidelines from the European Monitoring Centre for Drugs and Drug Addiction.¹³ Overlaps for the capture–recapture samples were obtained by asking participants in the second survey if they had participated in the first.

CIs were provided for all estimates. The usual Wald CI for a proportion was used to provide CIs for the estimates of the multipliers for MSM, SWs and IDUs. In order to calculate a CI for the national prevalence rates, the Clopper-Pearson procedure was used. This is based on the binomial sampling distribution and the lower and upper bounds of the CI are obtained by using the inverse β-distribution function $B^{-1}(a,b,c)$, a function which requires three parameters, the quantile a and the shape parameters b and c . The CI is given by

$$(B^{-1}(\alpha/2, k, n - k + 1), B^{-1}(1 - \alpha/2, k + 1, n - k))$$

with k equal to the number of the observed population and n the sample size.¹⁴ Standard CIs were also derived for the capture–recapture estimates.¹⁵

Design

To obtain the multipliers required for the multiplier and benchmark method, a cross-sectional standardised integrated bio-behavioural survey (IBBS) was conducted within the three cities of the three regions. The IBBS is an integrated biological and behavioural survey; seroprevalence data and data on the background information of the study participants, their knowledge and their risk behaviours are collected. Respondents were contacted in the field or at treatment centres and interviewed by researchers trained to work on the project. These surveys were originally conducted in 2007/2008 and were repeated in 2009/2010. The 2009/2010 survey was used within the prevalence estimation. Respondent driven sampling and a snowball sampling strategies were used starting in locations where respondents were known by service providers to frequent. The snowball sample was then used to form the multipliers. All derived multipliers and benchmarks are provided in the tables of results.

Inclusion criteria for SW were persons aged 18 and above who reported commercial sex in the last 12 months and who lived/worked in the particular city for at least the last 3 months. Inclusion criteria for MSM were men aged 18–59 who reported of having anal sexual intercourse with a male partner at least once in the last 6 months and lived in the city for at least the last 3 months. Finally, the inclusion criteria for IDU were persons aged 18 and above who injected a drug at least once in the last month and lived in the city at least the last 3 months. The time periods for the inclusion criteria across the three at risks groups differed and were chosen to reflect the different definitions of the risks. For example, within a drug-using population, a drug user who may have injected almost a year ago may not be

considered an active intravenous drug user, hence the inclusion criteria was, injected within the last month, whereas MSM may not be active within the last month, but would still be considered an active member of the MSM group.

In order to ensure sufficient numbers of respondents to correctly estimate the required multiplier for each group, a power analysis was conducted. The number of respondents required to detect the prevalence of a particular attribute with 95% confidence and with a 5% margin of error was computed based on the assumption that the population size of interest ranged from 10 000 to 30 000 persons and on the conservative basis that 50% of respondents may or may not possess the attribute. This analysis revealed that approximately 380 respondents were required within each of the three MARPs. The required sample size reduced to 246 respondents if the proportions responding yes or no for a particular attribute changed from 50 : 50 to 20 : 80 or 80 : 20.¹⁶

The protocol for the IBBS 2007/2008 and 2009/2010 received a formal ethical approval from the Institute of Public Health of Serbia. All clients participating in the IBBS provided a signed informed consent.

Data analysis

Data from the IBBS were analysed using SPSS V.12 and V.16. Capture–recapture estimates and all CIs were computed in Excel, and β-function values were also derived in Excel.

Prevalence estimation framework

In order to ensure that the estimates which are relevant and meaningful to treatment and intervention services were derived, a 3-day consultation workshop was organised to provide all relevant stakeholders with the background information to the prevalence estimates and to seek their input into the assumptions and limitations of the results. The researchers first proposed a framework for the prevalence estimation and this was discussed and agreed as an appropriate and relevant way forward. Once the approach was agreed, the elements of the process and the data required for each region were discussed and the assumptions and limitations debated. The researchers then gathered all the relevant data and computed the estimates. These estimates were then brought back to the members of the workshop and were presented for review, validation and agreement. A consultative approach among the workshop members, combined with local knowledge and international evidence, was used to select among the competing estimates. Workshop members included a range of service providers for the three MARPs, medical practitioners, psychiatrists, psychologists, nurses, social workers, senior virus laboratory staff, government officials, epidemiologists, field workers and researchers. There were approximately 25 members attending the workshop from across the country and the disciplines who came together to

explicitly provide their input to the prevalence estimation process.

Once consensus was reached, the research team prepared all final estimates. Additional members joined the workshop during the 3-day period and provided specific insight and background information on other possible data sources that may be made available for future prevalence estimation. The key components of the agreed framework were

- ▶ Estimates for each MARP to be presented separately;
- ▶ Within each of the MARPs estimates with 95% CIs for each region to be computed separately;
- ▶ Within each of the MARPs, a national minimum and a national maximum prevalence estimate with appropriate 95% CIs is to be provided;
- ▶ 1-year prevalence estimates based on 2010 or most recent data to be provided;
- ▶ As estimates were for service planning and policy development, estimates to be presented as absolute numbers rather than as rates;
- ▶ Estimates to be for adults aged 18–49 years where possible;
- ▶ Each estimate to be clarified and defined appropriately;
- ▶ Limitations of estimates to be clearly stated;
- ▶ Estimates to be validated by placing in national and international context;
- ▶ Recommendations for future estimates and possible data sources to be provided.

RESULTS

A total of 1301 respondents from the defined MARPs completed the survey in the 2009/2010 period across the three cities.

Demographics

Within Belgrade, 250 SW participated. Analysis revealed that the majority of study participants were women (62% women with n=155 and 38% men with n=95). Study participants ranged in age from 18 to 50 years or more, with the age group 25–49 years accounting for 64% of the overall sample. The sample comprised of men and women of Serbian, Roma and other ethnicities. Roma men accounted for 63% of the male SW sampled, while the majority of female SW (58%) were of Serbian ethnicity. The highest level of education attained differed for male and female SW. There was a greater spread in educational levels among women with 33% (n=51) of women not completing primary school or having no schooling compared with 22% (n=21) of men. Employment status was reported as unemployed for 87% of respondents.

A total of 480 MSM responded in either Belgrade or Novi Sad in the 2009/2010 period. Respondents ranged in age from 18 to 25 years or more, with the age group 25 plus accounting for the majority of the overall sample population in both regions. The majority of MSM sampled in both regions were of Serbian ethnicity with

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these proportions being 68% and 67% in Belgrade and Novi Sad, respectively. The highest level of education attained differed in the two sampled regions. In Belgrade, 49% of the population of MSM completed high school compared with 34% in Novi Sad. The employment status reported for 79% of the MSM in Novi Sad were students or employed and this was 71% in Belgrade.

Among IDUs, a total of 571 users who had injected within the last month responded in Belgrade and in Nis. In both regions, over three quarters of respondents were men (77% Belgrade and 88% Nis). The majority of IDUs were aged 25 years or over. In Belgrade, 58% of the population of IDUs completed high school, compared with 76% in Nis. Over 75% of the injecting drug use participants in Belgrade and Nis reported their employment status as unemployed.

Prevalence of SW

In order to estimate the prevalence of SW the enumeration method and the bench mark with a multiplier method was used. A multiplier based on the reported receipt of condoms from the JAZAS programme (an outreach programme for SW) was available from the IBBS for the Belgrade region only and this was multiplied by the benchmark of 846 SW contacts made by the JAZAS programme in 2009. CIs for the multiplier were also computed. Estimates for the remaining two regions were obtained from enumerating individuals within the 2010 programmatic data on numbers of SW contacted for those regions. Finally minimum national estimates were obtained from summing the three regional estimates and a maximum estimate was obtained by applying the prevalence rate for SW for Belgrade to the full national population aged between 18 and 49 years in 2009. An alternative approach could have been to sum the benchmarks from the three regions and apply the multiplier from the Belgrade region to this combined benchmark. This would have provided a new minimum estimate of 2914 individuals ((1343+258+235)/0.63=2914) but as the

IBBS multiplier and programmatic data differ the definition of this estimate would be unclear.

Full details are provided in [table 1](#).

Prevalence of MSM

Estimates of the prevalence of MSM were obtained using three methods, the benchmark and multiplier method; the capture–recapture method and a previously conducted national health survey.¹⁷ The capture–recapture method and the multiplier method were not available for the third region of the rest of Serbia. Within the multiplier method, two multipliers were available and these were the proportion who had reported within the IBBS that they had received condoms from outreach services and the proportion who had reported having been tested for HIV. Benchmarks were available for both of these two multipliers within Belgrade and Vojvodina (Novi Sad city only). Finally, within Belgrade and Novi Sad, it was possible to conduct a capture–recapture study by capturing participants in the IBBS 2009/2010 and a subsequent survey initiated between 3 and 4 months later of the known mapped so-called ‘hot spots’ for MSM. For the rest of Serbia, the prevalence rates of MSM could only be obtained from a national representative, household survey of health conducted in 2006 by the Serbian Ministry of Health. The results are provided in [table 2](#).

Prevalence of people who use drugs by injecting

Estimates of the prevalence of people who use drugs by injecting were obtained using two methods, the multiplier method and a national household survey.¹² Three multipliers were available from the IBBS and relevant benchmarks were also available. The three multipliers available were the proportion of IDU who had used needle exchange services, the proportion who had HIV testing and finally the proportion who had undertaken detoxification treatment in the previous year. The benchmark for the needle exchange multiplier was

Table 1 Most at risk population—sex work (SW)

Location	Year	Age group	Estimated prevalence	95% CI	Method and definition of estimate
Belgrade	2009/2010	18–49	1343	(1282 to 1410)	Multiplier ($m=0.63$) based on proportions reporting receiving condoms in 2009 from JAZAS as reported in the 2009/10 IBBS and benchmark ($n=846$) from JAZAS data on total contacts in 2009
Vojvodina	2010	18–49	258	–	Single source enumeration based on programmatic data for 2010
Rest of Serbia	2010	18–49	235	–	Single source enumeration based on programmatic data for 2010
National minimum	2009/2010	18–49	1836	(1775 to 1903)	Based on sum of regional estimates
National maximum	2009/2010	18–49	5740	(5479 to 6027)	Based on the Belgrade prevalence rate applied to the population aged 18–49 years from the 2009 estimated census

IBBS, integrated bio-behavioural survey.

Table 2 Most at risk population—men who have sex with men (MSM)

Location	Year	Age group	Prevalence estimate	95% CI	Method and definition of estimate
Belgrade	2009/2010	18–49	6797	(6574 to 7035)	Multiplier ($m=0.59$) from the 2009/2010 IBBS on proportions reporting receiving condoms in 2009 and benchmark ($n=4010$) from 2010 programmatic data
Belgrade	2009/2010	18–49	2629	(2374 to 2944)	Multiplier ($m=0.28$) from the 2009/2010 IBBS on proportions reporting receiving HIV testing in 2009 and benchmark ($n=736$) from the 2010 Voluntary Counselling and Testing (VCT) Data
Belgrade	2010	18–49	5990	(3700 to 8280)	Two Sample Capture Recapture(6-month period March '10– Sept '10)
Belgrade	2006	20–49	2957	(1314 to 3943)	National Health Survey 2006
Vojvodina*	2009/2010	18–49	8335	(7872 to 8856)	Multiplier ($m=0.34$) from the 2009/2010 IBBS on proportions reporting receiving condoms in 2009 and benchmark ($n=2834$) from 2010 programmatic data
Vojvodina*	2009/2010	18–49	838	(731 to 983)	Multiplier ($m=0.34$) from the 2009/2010 IBBS on proportions reporting receiving HIV testing in 2009 and benchmark ($n=285$) from the 2010 VCT Data
Vojvodina*	2009/2010	18–49	3782	(1668 to 5896)	Two Sample Capture Recapture(6-month period March—Sept '10)
Vojvodina	2006	20–49	10914	(6695 to 11121)	National Health Survey 2006
Rest of Serbia	2006	20–49	17996	(12780 to 18125)	National Health Survey 2006
National minimum	2006	20–49	31867	(20789 to 33189)	National Health Survey 2006
National maximum	2009	20–49	89507	(88910 to 90104)	Based on 2009 estimated census population and internationally recognised figure of 6% [†] of world population comprised of MSM

*Based on data from Novi Sad only.

†Retrieved from <http://www.kinseynstitute.org/resources/bib-homoprev.html> on 7 July 2011.

IBBS, integrated bio-behavioural survey.

programmatic data on numbers in receipt of needles; the other two benchmarks were numbers who had HIV testing and detoxification treatment in the time period matching the multipliers. Details on all results for this group are provided in table 3.

DISCUSSION

The principal finding from this study was the first estimates of the prevalence rates of the size of the populations of most at risk of HIV/AIDS within the Republic of Serbia. The estimates of the prevalence of SW ranged from 0.11% to 0.43%, estimates of the prevalence of MSM ranged from 1.4% to 5.9% and finally the estimates of the rates of people who use drugs intravenously ranged from 0.27% to 1.6%. However, the estimates need to be interpreted in light of the methodological limitations.

As a snowball sample was used to form the multipliers for some estimates, a potential bias may have been introduced into the estimates. It is recognised that multipliers formed in this way are arguably derived from social networks known to service providers and may, as a result, produce underestimates of prevalence. Also, as the time

period for the inclusion criteria for the multipliers for the three MARPs differed from within the last month to within the last year, a comparison of estimates across MARPs needs to be interpreted with caution. The majority of the estimates were produced using either the multiplier method, national surveys or the two sample capture–recapture methods. However, within prevalence estimation methodology, it is recommended that the three sample capture–recapture is preferable or the multiple indicator methods based on more than two anchor points. Within this study, it was not possible to implement the three sample capture–recapture method as three separate samples were not available for any of the MARPs. To implement the multiple indicator method, anchor points, which provided details on prevalence at two locations, would be required and again these data were not available. A full and practical discussion of the details of the implementation of these additional methods is provided elsewhere.¹⁰

The IBBS for SW was only carried out in one region (Belgrade); this limited the results considerably. Furthermore, the benchmark for the estimate was based on the number of SW contacts rather than on unique individuals because of limitations in the programmatic

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Table 3 Most at risk population—injecting drug users (IDU)

Location	Year	Age group	Prevalence estimate	95% CI	Method and definition of estimate
Belgrade	2009/2010	18–49	3243	(3121 to 3376)	Multiplier ($m=0.51$) from the 2009/10 IBBS on proportions reporting receiving needles in 2009 and benchmark ($n=1654$) from 2010 needle exchange programmatic data
Belgrade	2009	18–49	4273	(3357 to 5875)	Multiplier ($m=0.11$) from the 2009/10 IBBS on proportions reporting receiving HIV testing in 2009 and benchmark ($m=470$) from 2009 data on counts of individuals from the Special Hospital for drug use testing
Belgrade	2009	18–49	13040	(10867 to 16300)	Multiplier ($m=0.10$) from the 2009/2010 IBBS on proportions reporting receiving detoxification treatment in 2009 and benchmark ($n=1304$) from 2009 counts of individuals receiving detoxification treatment
Vojvodina*	2007/2010	18–49	2893	(2382 to 3682)	Multiplier ($m=0.14$) from the 2007/2008 IBBS in Novi Sad on proportions reporting receiving needles in 2007 and benchmark ($n=405$) from 2010 needle exchange programmatic data
Vojvodina*	2007	18–49	1690	(1127 to 3380)	Multiplier ($m=0.10$) from the 2007/2008 IBBS in Novi Sad on proportions reporting testing for HIV in 2007 and benchmark ($n=169$) from Vojvodina HIV Testing in 2007
Vojvodina*	2007	18–49	1640	(845 to 27333)	Multiplier ($m=0.05$) from the 2007/08 IBBS in Novi Sad on proportions reporting receiving detoxification treatment in 2007 and benchmark ($n=82$) from 2007 counts of individuals receiving detoxification treatment
Rest of Serbia†	2009/2010	18–49	1057	(980 to 1147)	Multiplier ($m=0.51$) from the 2009/10 IBBS in Nis on proportions reporting receiving needles in 2009 and benchmark ($n=539$) from 2010 needle exchange programmatic data
Rest of Serbia†	2009	18–49	340	(113 to unknown)	Multiplier ($m=0.05$) from the 2009/10 IBBS in Nis on proportions reporting HIV testing in 2009 benchmark ($n=17$) from counts of HIV tests at IPH Nis Testing in 2009
Rest of Serbia†	2009	18–49	2967	(2225 to 4450)	Multiplier ($m=0.06$) from the 2009/10 IBBS in Nis on proportions reporting receiving detoxification treatment in 2009 and benchmark ($n=356$) from 2009 counts of individuals receiving detoxification treatment
National minimum	2006	15–59	12682	—	National Survey on Narcotics 2006
National maximum	2008/2009	18–49	48083	—	Sum of the upper bound of the 95% CI for detoxification

*Based on data from Novi Sad only.

†Based on data from Nis only.

IBBS, integrated bio-behavioural survey.

data for Belgrade. In addition, the definition of the estimate applied to a narrow group of SW working on streets and in clubs as opposed to the more hidden sex work within hotels, within advertisements and in private clubs, saloons or agencies. Also, the estimates for Vojvodina and the rest of Serbia were clearly an underestimate as they were derived simply from counting the number of unique known individuals from within the programmatic data for those cities. As a result, the national minimum estimate was likely to be an

underestimate and the national maximum estimate was likely to be an overestimate as it was based on a multiplier from Belgrade data.

The Serbian national strategy for HIV infection and AIDS¹⁸ presents a range of goals for HIV/AIDS prevention, treatment and capacity building for the period 2011–2015. For SW, the strategy has a goal that 75% of all such workers will always use condoms with clients. From the IBBS survey results in table 1, analysis revealed that among those surveyed 63% stated they had received

condoms and a total of 846 contacts were made by JAZAS the organisation working with SW. Given these data, it was not possible to ascertain how many SWs were always using condoms, but estimates of prevalence presented within this research illustrated that JAZAS contacts accounted for approximately 21.7% of the estimated population (846 contacts given a population of 3901 individuals). Clearly, for the strategy goals to be realised, the number of individuals accessed by JAZAS needs to be both increased and recorded at the individual level.

Within the MSM populations, some estimates appeared to be low by international comparison. This was a result of several limitations in the IBBS and the capture/recapture study. First, it was observed within the IBBS demographic results above for MSM that the majority of survey respondents were over 25 years of age both in Belgrade and Novi Sad; hence, the multipliers obtained from the sample surveyed may not have reflected the true population. Second, within the capture-recapture methodology, the first sample was captured via the IBBS survey and the second was captured at the so-called known hot spots. The choice of location of the two samples may have caused a violation in the assumption of the homogeneity of capture probability which may have resulted in different definitions of MSM or in less individuals being captured. Furthermore, at the expert consultation workshop, field-workers stated that many of the participants surveyed were in fact under 35 years of age and were the more visible population who reach their partners in parks and public places rather than the more hidden population of men who find partners via the internet and private clubs and parties and this was reflected in the findings of the capture-recapture survey. The opinion that the true population was not reflected in the survey was reiterated strongly by the participants attending the expert consultation workshops. Furthermore, the estimates obtained within the national health survey of 2006 were also low by international comparison.

With regard to programmatic targets for MSM, the national strategy¹⁵ sets a goal that states that 80% of all MSM use condoms during anal sexual intercourse. Data from the IBBS survey revealed that 59% of MSM within Belgrade and 34% of MSM in Vojvodina reported receiving condoms from services. Clearly, the IBBS needs to be modified to capture the correct data for measurement of the strategic goal.

Within the IDU results, several limitations must be highlighted. As harm reduction treatment coverage for substance use within Serbia is very limited, benchmarks for the first two multipliers were very low and this was reflected in the prevalence estimates for these two approaches. The primary treatment for substance use was detoxification, and as a result, more reasonable estimates were obtained from the detoxification multiplier. As the detoxification modality of IDU treatment was the most common, it was reasonable for planning purposes to use estimates from this method. The national

minimum and maximum were selected to give a range of a possible 12 682–48 083 IDU individuals aged 15–59 in the Republic of Serbia. As CIs for some regions were very wide, this may have inflated the national maximum. However, it was also interesting to note that the lower part of this interval derived from the national minimum estimate based on the 2006 national population survey was similar to the sum of the lower bound of the 95% CI of the estimate derived from the summation of the three city detoxification multipliers which was 13 937 IDU, but this result may have been due to chance. A further limitation was the fact that estimates for the regions are based solely on data from the cities within those regions (Novi Sad and Nis) and not on the full region and this is also likely to lead to an underestimate. Finally, the upper estimate provided was based on a national household survey and it is recognised that IDUs may fall outside of the sampling frame for such surveys due to problems with unstable accommodation. As a result of these limitations, this upper bound may be too conservative.

For planning of services for IDU, it must be remembered that estimates produced were for IDUs only and did not provide estimates of the numbers using opiates or other drugs non-intravenously. The national strategy¹⁵ sets a target of 40% for all IDU using sterile injecting equipment. From the IBBS, it was observed that proportions ranged from 14% in Vojvodina to 51% in Belgrade and Nis. However, the numbers of known individuals within needle exchange programmes were only 5.4–20.5% of the estimated population and this proportion was lower within methadone treatment data. Also, as the numbers on methadone substitution treatment were very low by international standards, it was likely that the wider problem drug-using group may be much larger and may represent a significant pool of individuals at future risk of HIV in the Republic of Serbia. The demographics and drug-using habits of this population need to be closely monitored to ensure that the Republic of Serbia remains a low-risk country for HIV/AIDS among this at risk population.

To conclude, the results presented highlight how a range of data sources (of varying quality) and methods can be triangulated to produce credible estimates for planning and for monitoring and evaluation for the benefit of both service providers and future service users. Future estimates could be improved by ensuring that benchmarks and multipliers obtained from the IBBS survey reflect the same time period and the same definition of the most at risk population; that the IBBS survey among MSM reflects a wider age range; that the IBBS survey of SW is conducted in more than one city; that the benchmarks always count unique individuals rather than contacts; and finally that the capture-recapture study is extended to three data sources for all three MARPs.

Contributors DS and SB led the conception and design of the study. CC and OD led the analysis and interpretation of the data. CC led the drafting of the article and revising it critically for important intellectual content. All authors contributed to the final version and final approval of the version to be published.

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REFERENCES

1. Farren E, Blanchard J, Zaheer H, et al. The HIV/AIDS surveillance project mapping approach: an innovative approach for mapping and size estimation for groups at a higher risk of HIV in Pakistan. *AIDS* 2010;24:S77–84.
2. Abdelrahim M. HIV prevalence and risk behaviours of female sex workers in Khartoum, north Sudan. *AIDS* 2010;24(Suppl 2):S55–60.
3. Townsend L, Johnston L, Flisher A, et al. Effectiveness of respondent-driven sampling to recruit high risk heterosexual men who have multiple female sexual partners: differences in HIV prevalence and sexual risk behaviours measured at two time points. *AIDS Behav* 2010;14:1330–9.
4. van Veen M, Presanis A, Conti S, et al. National estimate of HIV prevalence in the Netherlands: comparison and applicability of different estimation tools. *AIDS* 2011;25:229–37.
5. Republic of Serbia National AIDS Commission. <http://www.unaids.org/es/dataanalysis/monitoringcountryprogress/progressreports/2012countries/file,68427,es.pdf> (accessed 6 Jul 2012).
6. United Nations General Assembly Special Session on HIV/AIDS. http://www.unaids.org/en/media/unaids/contentassets/dataimport/pub/manual/2009/jc1676_core_indicators_2009_en.pdf (accessed 6 Jul 2012).
7. The Global Fund to Fight AIDS, Tuberculosis and Malaria, Toolkit, Part 2. <http://www.theglobalfund.org/en/me/documents/toolkit/> (accessed 6 Jul 2012).
8. <http://media.popis2011.stat.rs/2012/DBR%2032272%20-%20Population%20Dashboard%20v16.swf> (accessed 6 Jul 2012).
9. Comiskey C. Methods for estimating prevalence of opiate use as an aid to policy and planning. *Subst UseMisuse* 2001;36:131–50.
10. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). *Methodological Guidelines to Estimate the Prevalence of Problem Drug Use on the Local Level*. Lisbon: EMCDDA, 1999. <http://www.emcdda.europa.eu/html.cfm/index58064EN.html> (accessed 9 Jan 2012).
11. Institute of Public Health of Serbia. Health of population of Serbia, analytical study 1997–2007, 2007. <http://www.batut.org.rs/download/publikacije/Health%20of%20population%201997–2007.pdf> (accessed 5 Jan 2013).
12. Strategic Marketing Narcotics in Serbia. 2006. <http://www.emcdda.europa.eu/publications/country-overviews/rs#gps> (accessed 5 Jan 2013).
13. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). *Handbook for surveys on drug use among the general population*. Lisbon: EMCDDA project CT.99.EP.08 B, EMCDDA, 2002. <http://www.emcdda.europa.eu/html.cfm/index58052EN.html> (accessed 6 Jul 2012).
14. National Advisory Committee on Drugs, Ipsos MORI. *Drug prevalence survey 2006/2007 technical report*. Dublin, Ireland: NACD, 2008. http://drugsandalcohol.ie/11587/1/NACD_Survey_06-06_Technical-report.pdf (accessed 6 Jul 2012).
15. Sekar Chandra C, Deming E. On a method of estimating birth and death rates and the extent of registration. *J Am Statist Assoc* 1949;44:101–15.
16. Naing L, Winn T, Rusli B. Practical issues in calculating the sample size for prevalence studies. *Arch Orofacial Sci* 2006;1:9–14.
17. Ministry of Health of Republic of Serbia, Institute of Public Health of Serbia ‘Milan Jovanovic Batut’, 2008. Surveys among most at risk populations for HIV and among people living with HIV, Ministry of Health of Republic of Serbia, Belgrade 2008.
18. Ministry of Health of Republic of Serbia,. Strategy on HIV Infection and AIDS 2011–2015, 2010. http://www.unicef.org/ceecis/NATIONAL_HIV-AIDS_STRATEGY_ENG.pdf (accessed 12 Jan 2013).